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ABSTRACT

Public pressure for expansion of secondary and higher education has forced governments of several developing countries to urgently seek ways to meet this demand. Many of these countries have been hard hit by debt and high world interest rates. At their 1984 conference, Commonwealth Ministers of Education requested the Secretariat to examine ways to improve use of existing resources for education, and to find alternative sources of finance. To meet this request, the Secretariat drew up a program of workshops. This document is the chief product of a workshop held in the Caribbean to discuss cost-effective teaching of secondary school prevocational subjects. Thirteen chapters are divided into four sections: (1) Preliminary Issues; (2) Making Efficient Use of Expensive Components; (3) Generating Extra Resources; and (4) Conclusions. A choice is offered between two main policy objectives: whether practical subjects are regarded as part of general education preparing students for life, or whether they are considered prevocational, or even vocational, giving specific skills and leading straight into particular occupations in the world of work. Particular attention is paid to the special facilities, equipment, staffing, and class sizes usually required by practical subjects. A list of suggested readings is included. (LAP)

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Practical Secondary Education:

Planning for Cost-Effectiveness in Less Developed Countries

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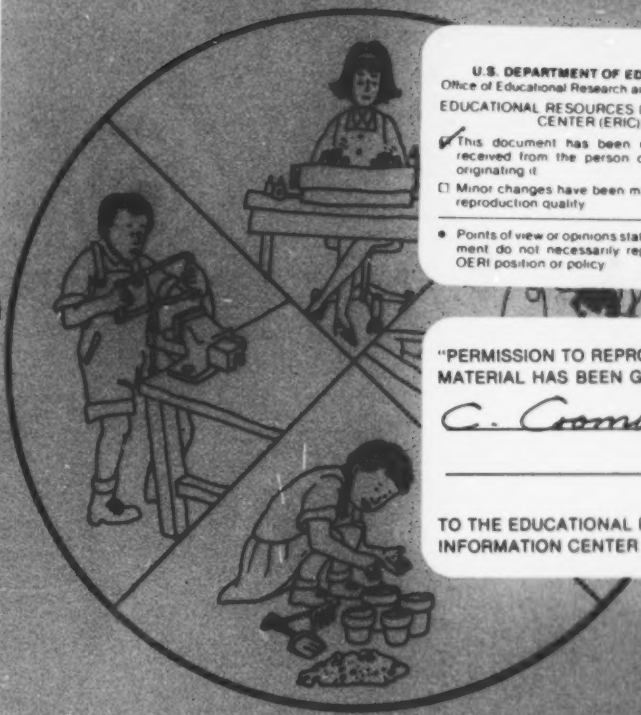

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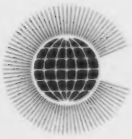
Planning for Cost-Effectiveness in Less Developed Countries

Dennis Chisman



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Foreword

Many governments currently face a bleak economic outlook. Developing countries in particular have been hit by droughts and bad harvests. They face static or declining markets for their exports, and escalation of import costs has squeezed their finances to the very limit. Many countries are heavily in debt, and world interest rates are high. In consequence, governments find themselves in a financial strait-jacket.

At the same time, the public clamour for expansion of secondary and higher education has forced governments urgently to seek ways to meet demand. At their 1984 conference, Commonwealth Ministers of Education requested the Secretariat to examine ways (a) to improve use of existing resources, and (b) to find alternative sources of finance.

To meet this request, the Secretariat drew up a programme of workshops. The first was held in Africa, and looked at ways in which community efforts can be mobilised to supplement government funds. A second workshop was held in the Pacific to compare the costs of small schools with the costs of large ones. And a third workshop was held in the Caribbean to discuss cost-effective teaching of secondary school pre-vocational subjects. In addition, the Secretariat commissioned Maureen Woodhall to write a guidebook for governments considering introduction of student loan programmes.

This book is the chief product of the Caribbean workshop. Its precise subject was chosen after consultation with educators in the region. Their views reflected the concern of many Ministers of Education at the growing number of unemployed school leavers, a desire to see secondary school curricula made more relevant to life after school, and a recognition that vocationalisation of education has heavy cost implications.

The workshop itself was held from 19 to 26 June 1986 in Port of Spain, Trinidad & Tobago. It was attended mainly by secondary school principals, educational supervisors, examiners, and administrators concerned with practical subjects. Its proceedings, of course, were mainly shaped by Caribbean educators; but I feel confident that people

in other countries can also benefit from the analysis that has been distilled and presented here.

Peter R.C. Williams,
Director, Education Programme,
Human Resource Development Group,
Commonwealth Secretariat.

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Introduction

(a) For Whom is this Book Intended?
The book has mainly been written for three groups of people:

1. Planners and administrators who allocate resources to different types of schools,
2. Supervisors and inspectors who advise on the most effective use of resources within schools, and
3. Secondary school principals responsible for day-to-day teaching of practical subjects.

As well as providing ideas which will directly assist the work of these people, the book will also help in an indirect way. Officers at different levels in the education system often have different perspectives on the same problems. For effective teamwork, everybody needs to understand the viewpoints of the others. The book will help them to do this.

(b) What are Practical Subjects?
In some ways, all subjects can be practical. Mathematics has a practical use in the home and in business, languages have a practical use in communication, science has a practical use in industry, etc..

However, in curriculum matters the label is usually reserved for subjects which specifically require students to use their hands. The main ones covered by this book are:

Agricultural Science:	Agriculture Animal Husbandry Horticulture
Business Studies:	Accounting Bookkeeping Computing

	Office Management
	Principles of Business
	Shorthand
	Typing
	Word-Processing
Home Economics:	Beauty Culture
	Clothing & Textiles
	Cookery
	Dressmaking
	Food & Nutrition
	Home Management
	Hotel & Catering
	Needlework
	Tailoring
Industrial Arts:	Air Conditioning
	Automechanics
	Building
	Electrical Installation
	Electronics
	Marine Sciences
	Masonry
	Metalwork
	Refrigeration
	Technical Drawing
	Plumbing
	Woodwork.

Practical subjects are usually contrasted with academic ones such as English literature, history, physics, biology and mathematics. Although these subjects may have a practical component (particularly in the sciences), most teaching and learning is from books.

Two terms that are related to the debate on practical subjects are *diversification* and *vocationalisation*. Many governments use these terms when they add practical subjects to an academic curriculum.

The Breadth of Subject Offerings

Most countries in the Caribbean — including the small ones — offer a wide range of practical subjects in their secondary schools. For example:

Antigua & Barbuda *offers 5 industrial arts subjects, 4 home economics subjects, business education, agricultural science and building.*

Barbados *offers 7 industrial arts subjects, 3 home economics subjects, 5 business studies subjects, and agricultural science.*

Jamaica *offers 31 pre-vocational and technical subjects.*

Trinidad & Tobago *offers 17 craft courses, 13 pre-technical courses and 4 advanced level courses.*

St Vincent *offers 4 industrial arts subjects, 4 home economics subjects, 5 business studies subjects, and agricultural science.*

St Lucia *offers 7 subjects at the junior secondary level and 13 subjects at the senior secondary level.*

(c) Alternative Strategies

The different patterns in which practical subjects are offered reflect a choice between two main policy objectives:

* whether practical subjects are regarded as part of general education preparing students for life, or
* whether they are considered pre-vocational or even vocational, giving specific skills and leading straight into particular occupations in the world of work.

This book covers both options. The policy objectives help determine whether subjects should be compulsory for all students or whether they

should be optional. If the latter is chosen, the authorities still have to decide whether options will be available to *all* students or whether they should be limited to a few streams.

At the junior secondary level, the usual pattern in the Caribbean is for practical subjects to be part of general education and to be compulsory. However, there is often gender stereotyping, e.g. of home economics for girls, and woodwork, metalwork or industrial arts for boys. In some countries, agricultural science is also considered part of general education for all students.

At the senior secondary level, by contrast, practical subjects are usually offered as options, grouped according to the main areas of industrial arts, agriculture, home economics and business studies. In some countries students are counselled in the selection of options, but important choices always have to be made at the age of 14 or 15 (Form 3 of secondary school). Often, the basic choice is between an academic stream or one of several technical/vocational streams.

Part I:
Preliminary Issues

1. The Concept of Cost-Effectiveness

This first chapter outlines the meaning of the cost-effectiveness, and indicates ways in which it can be assessed.

(a) What is Cost-Effectiveness?

Cost-effective investments may be defined simply as the ones that produce the best results from a fixed set of inputs. Policy makers normally use cost-effectiveness analysis when they have already identified a goal and want to decide on the best way to achieve it.

Sometimes, administrators start with fixed budgets: a project's financial ceiling has already been set, and the administrators want to know how money can be spent in the best possible way. On other occasions they have no fixed budget in mind, but want to know how to invest resources wisely. And on yet other occasions they have to *cut* budgets by a certain amount, and need to know how to do so. In all cases, they can use cost-effectiveness analysis to compare different strategies and decide on the best action.

An Example

The nature and purpose of analysis may be explained by an example. This one is entirely fictitious, but demonstrates the method.

Suppose that educational administrators want to improve the examination scores of a group of woodwork students. They can assess cost-effectiveness in five steps:

Step 1: Identify Alternative Ways to Achieve the Goal
In this case, suppose that they identify three alternatives:

i) employing a special instructor to work with small remedial groups;
ii) designing a programme for self-instruction, in which students work at their own pace in a special resource room with special curriculum material and a coordinator; and
iii) purchasing extra library books for students to read by themselves.

Step 2: Work out the Costs of Each Strategy
i) The first method would have a high cost. Because of its low pupil: teacher ratio, the administrators estimate a cost of $100 per student.
ii) The second one would require a special room, materials and a coordinator. But it could cater for 20-25 students at a time, so would only cost an estimated $49 per student.
iii) The third method would be the cheapest. It would only cost $16 per student.

Step 3: Estimate the Effectiveness of Each Strategy
The effectiveness of each strategy can be determined by comparing the test scores of students who gain help with those of similar students who receive no help. On the basis of research studies and their own experience, the authorities decide that:

i) the first method would improve each pupil's score by 10 points,
ii) the second method would improve each pupil's score by 7 points, and
iii) the third method would improve each pupil's score by 2 points.

Step 4: Combine the Information in a Table
It is combined as follows:

Method	Cost per Student (a)	Effectiveness (test score) (b)	Cost-Effectiveness (a) + (b)
Small Groups	$100	10	$10
Self-Instruction	$ 49	7	$ 7
Library books	$ 16	2	$ 8

Step 5: Analyse the Results
From the table, two main points emerge:

* Self-instruction is the most cost-effective. It costs only $7 to increase a pupil's score by one point, compared with $8 for library books and $10 for small group instruction.
* In this case, the most cost-effective strategy is *not* the cheapest. Library books are the cheapest; but the administrators do not expect them to have much effect (perhaps because the examination places more emphasis on practical skills than on theory, and because the students are unlikely to make active use of the books).

(b) Some Difficulties
The above example illustrates the main principle of cost-effectiveness analysis: that it combines information on costs with information on effectiveness to reach a conclusion on the best development strategy. As readers go through this book, however, they will become aware of two major difficulties in the context of practical secondary education:

* *Measurement of Costs*: Few administrators have accurate data on costs. Because of the way government budgets are constructed it is often hard to compare expenditure on practical subjects with expenditure on other ones. In addition, some practical subjects allow schools to *earn* money. Ideally, these earnings should be set against the costs; but they may be hard to estimate in advance.
* *Measurement of Effectiveness*: Many of the benefits of a practical curriculum are hard to measure. For example, one common objective is a change in attitudes among young people. But these are very hard to quantify. And since many other factors contribute to changes in attitudes, it may be hard to identify the specific contribution of practical subjects.

In addition, all assessments of cost-effectiveness have to anticipate possible changes. Present costs, for example, may not be the same as future ones. And the effectiveness of individual inputs may not proportionately increase with scale. Thus, although in the example just given self-instruction seemed to be the most cost-effective method, the authorities could not assume that continual investment of more resources in self-instruction would produce constant benefits in the same

proportion. Factors such as these make cost-effectiveness analysis very complicated.

At the same time, however, administrators always know that they are *not* using resources cost-effectively if there is considerable inefficiency. Often the first step to improved cost-effectiveness is improved efficiency. The second step is determination of alternative policies through the type of comparative analysis noted above.

Cost-Effectiveness and Cheapness

Cost-effectiveness is not necessarily the same as cheapness: some strategies may be cheap but ineffective. Sometimes it is worth investing more *money on a project, choosing a higher-cost strategy that also has higher cost-effectiveness.*

However, cost-effectiveness can always be increased by improving efficiency. *If one strategy uses more resources to achieve the same goal as another strategy, then it is both less efficient and less cost-effective than it could be.*

2. The Aims of Practical Curricula

This chapter has three sections. It discusses (a) the justification for teaching practical subjects, (b) the most appropriate stage for them in the education system, and (c) some common but unrealistic expectations.

(a) Why Teach Practical Subjects?

Most governments consider practical subjects a way to develop appropriate skills and attitudes. The Minister of Education in Belize, for example, has declared:

> Our education system must integrate the world of study with the world of work. A school cannot be divorced from its social and economic environment. The value and dignity of work starts in the home, but must be pursued in the schools. Our young people should come out of school with some measure of marketable skills, and should be well disposed to work with hands and minds in every sector of the country's economy.

Similar views are held by many other government and community leaders.

Although practical subjects have long been taught in schools all over the world, recent years have seen an upsurge of interest in them. Rising school-leaver unemployment has been the main cause of this. Governments are anxious to avoid the social problems that arise from unemployment. They also recognise that people without work are a wasted resource, and it is important for all manpower to be put to productive use. Governments commonly assert that a practical school curriculum can reduce unemployment and thus help both individuals and the nation as a whole.

Practical subjects aim to reduce unemployment in two ways:

* they try to give young people skills which employers are likely

to want, and

* they try to give young people skills for *self*-employment.

Practical education, it is commonly asserted, can also help the schools themselves to:

— balance the general atmosphere and prevent it from becoming too 'bookish';
— gain a better reputation through a more relevant curriculum;
— gain revenue from sale of products; and
— more easily gain resource support from communities and businesses.

Finally, many governments emphasise the direct psychological and social benefits from a practical school curriculum. They point to the danger of elitism if people with academic education look down on people who work with their hands. The advocates of practical education often point to past times in which manual labour has had greater dignity, and they seek to restore its status. And as well as helping society as a whole, it is suggested, practical subjects can also help individuals.

The Benefits of Practical Education

To the Nation:
- *economic development,*
- *social development.*

To the School:
- *more balanced atmosphere,*
- *enhanced reputation for relevance,*
- *revenue from sale of products,*
- *improved potential for resource support from communities and businesses.*

To the Individual:
- *improved self-image for weak academic performers,*
- *improved wage-earning prospects,*
- *improved self-employment prospects,*
- *access to creative leisure opportunities.*

(b) Practical Education at what Level?

Because primary school children are too small for heavy manual labour, effective teaching of practical subjects is hard to introduce at that level. By the time children enter secondary school they are older, they have begun to show what sorts of things they are good at, and they have better ideas of the work that they are likely to do as adults.

Because choice of subject options has such a strong implication for final careers, however, many governments try to retain flexibility as long as possible. They commonly have a broad junior secondary curriculum which can be followed by all students, and only require specialisation either at the senior secondary level or in separate technical/vocational colleges.

The pattern is St Lucia is fairly typical of the Commonwealth Caribbean. Students are obliged to take at least one of seven practical subjects at the junior secondary level, and 13 other subjects are offered as options at the senior secondary level:

Subjects offered at the junior secondary level:

Agricultural Science,
Art & Craft,
General Electricity,
Graphics,
Home Economics,
Metalwork,
Woodwork.

Subjects offered at the senior secondary level:

Agricultural Science,
Bookkeeping,
Clothing & Textiles,
Food & Nutrition,
General Electricity,
Home Management,
Metals,
Office Practice,
Principles of Accounts,
Principles of Business,
Technical Drawing,
Typing,
Woodwork.

(c) Unrealistic Expectations

As already mentioned, practical secondary education is not a new idea. In most Third World countries, missionaries and government education officers have placed great stress on manual work since the introduction of schooling. Often, for reasons that should be noted, their efforts have borne little fruit.

(i) Practical Education and Jobs

The word 'job' refers to formal, wage-earning employment. Jobs may be contrasted with self-employment, which is discussed in the next section.

In any country, the supply and nature of available jobs is determined by a great many factors, of which very few are under the control of the Ministry of Education. They include:

— the nature of international competition,
— the size of the local market,
— availability of raw materials,
— the types of technology employed,
— prevailing interest rates,
— regulations on employment, minimum wages and trade unionism, and
— the skills of the labour force.

Introduction of practical subjects in secondary schools can have some effect on the last of these. However, many employers require such specific skills that all real training is either done on the job or is sponsored by employers at the post-secondary stage. By themselves, therefore, practical subjects in the secondary schools can do very little to *create* jobs.

(ii) Practical Education and Self-Employment

It is also hard for practical secondary education to generate effective self-employment. The skills taught in schools are often too shallow, and individuals need many complementary skills to become successful. In particular, they need knowledge of:

— places and ways to obtain raw materials,
— places and ways to sell their services/finished products,

— ways to protect machinery from theft and accidental damage,
— methods of accounting,
— types and benefits of insurance, and
— places and ways to borrow money.

In societies with strong family systems, the successful entrepreneur must also know how to honour social obligations without being exploited by them. For example, many small retail businesses have been made bankrupt by general expectations that the storekeeper will give free or low-priced goods to relatives and friends. But this type of required skill cannot easily be taught in the secondary school.

(iii) Practical Education and Attitudes

The third common hope is that introduction of practical subjects will change pupils' attitudes, and make secondary school graduates more willing to work with their hands. There may be some force in the idea. However, a much stronger determinant of attitudes is the structure of the economy. If pupils see that manual workers receive lower incomes and work much harder than non-manual ones, they are unlikely to change their job preferences.

This fact partly explains the scale of youth unemployment in less developed countries. Although individuals know that they could make some money by becoming self-employed entrepreneurs, they also know that they could make much more money (and have better working conditions and security) in wage-earning jobs. It often makes sense for these individuals to refuse to become self-employed and instead to devote their time to job-hunting. Although very few people succeed, the rewards may be sufficiently high to make the gamble worth trying.

3. Unit Costs and their Calculation

A unit cost is the cost of educating one pupil for one year. It is composed of both capital and recurrent components:

Capital costs arise from expenditure on long-lasting items, e.g. land, buildings, equipment, furniture and library books.

Recurrent costs arise from day-to-day needs. In education, the greatest recurrent costs are teachers' salaries. Other ones are electricity, gas, water, exercise books, chalk, maintenance of buildings, and maintenance of equipment.

Part II of this book shows that both capital and recurrent unit costs are usually higher in practical than in other subjects. Practical subjects require more expensive buildings and equipment, and are usually taught to smaller classes. In addition, teachers of practical subjects often attract higher salaries than others, and they often have to be supported by technicians and other staff.

(a) Unit Capital Costs

Unit capital costs are calculated by dividing the total capital costs of education in one year by the number of pupils. Because buildings are long-lasting and are not 'used up' within a year, only a percentage of their construction cost should be taken. This calculation is called 'amortisation'.

The method of calculating unit capital costs may best be explained by an example:

Assume a typical secondary school with a diversified curriculum. It wants to introduce metalwork, but has to construct the workshops. The school has 875 students, but only 674 of them will take metalwork.

(i) Total Costs:

(a) Size of each workshop	*250 sq. metres*
(b) Construction cost	*$482 per sq. metre*
(c) Construction cost of one workshop	*$120,500*
(d) Cost of equipment	*$22,600*
(e) Cost of furniture	*$3,100*
(f) Total cost (c) + (d) + (e)	*$146,200*
(g) Number of workshops required	*2*
(h) Total cost of 2 workshops	*$292,400*

(ii) Amortisation:

(a) Average useful life of buildings	*25 years*
Cost per year	*$4,820*
(b) Average useful life of equipment	*10 years*
Cost per year	*$2,260*
(c) Average useful life of furniture	*15 years*
Cost per year	*$207*
(d) Total cost per year	*$7,287*

(iii) Unit Capital Cost:

Total cost per year divided by the number of students	
$7,287 ÷ 674	*$10.81*

(b) Unit Recurrent Costs

The method for calculating unit recurrent costs may be shown by continuing the above example:

Assume that the school has: 5 grades (Grades 7-11)
5 classes in each grade, and thus
25 classes altogether.

Each class has 33 pupils. In Grades 7, 8 and 9, all pupils have to take 2 periods of metalwork each week. Students in Grades 10 and 11 specialise; some do not take any metalwork, some take a little, and some take a lot. The different streams in Grades 10 and 11 have to be taught separately.

(i) Number of Periods and Pupils:

		Periods	*Pupils*
Grades 7, 8 & 9:			*495*
	(each 5 classes × 33 pupils)		
	(each 5 classes × 2 periods)	*30*	
Grade 10:	*Arts Stream*	—	—
	Science Stream	*2*	*33*
	Automotor Stream	*7*	*31*
	Commerce Stream	—	—
	Building/Construction Stream	*4*	*28*
Grade 11:	*Arts Stream*	—	—
	Science Stream	*1*	*25*
	Automotor Stream	*7*	*33*
	Commerce Stream	—	—
	Building/Construction Stream	*4*	*29*
	TOTALS:	*55*	*674*

(ii) Teacher Costs:

Assume: • *normal load is 28 teaching periods per week. 55 ÷ 28 = 1.96. Rounding up, this becomes 2 teachers.*

• *the total costs for each teacher for one year (i.e. salary + pension + bonuses + travel etc.) are $11,250.*

$11,250 × 2 = $22,500

(iii) Other Salary Costs:

Assume: • *2 technicians are required. Total annual costs for each are $8,500. For both of them, therefore, the total cost is $17,000.*

• *extra costs of cleaners, night watchmen and administrators amount to $4,500.*

(iv) Costs of Materials:

Assume raw materials, electricity, gas, etc. cost $10 per pupil. $10 × 674 = $6,740

(v) Total Costs:

Teachers	*$22,500*
Technicians	*17,000*
Cleaners etc.	*4,500*
Materials	*6,740*
	TOTAL: $50,740

(vi) Unit Costs:

Total cost per year divided by the number of students

$50,740 ÷ 674 = $75.28

(c) Assumptions in Cost Analysis

The assumptions underlying a cost calculation can make a big difference to the result, and should be examined very carefully. It is particularly important to check that reasonable estimates have been made for salaries, materials and the life of buildings and equipment.

In addition, three further points should be made:

* *Average Costs or Marginal Costs?* Note that item (iii) in this calculation shows only the extra costs of cleaners, night watchmen, administrators, etc.. It assumes that people are already being employed for the school, and thus calculates only the extra needs for the workshops. This is called the *marginal* cost.

  However, planners often prefer to calculate the *average* cost, i.e. the total cost of all cleaners, night watchmen and administrators divided by the total number of pupils. The figure may be quite different. If people had to be specially appointed because of the construction of the workshops, marginal costs would probably be higher than average costs. But if people were already employed and were just given extra duties, marginal costs would be lower than average costs.
* *Only the Metalwork Students or All the Students?* The unit cost was based only on the 674 students who will actually take metalwork, not the 875 students in the school as a whole. If the authorities had decided to divide by the total number of students, they would have reached a lower figure.
* *Current Enrolments or Future Enrolments?* The figure of 674 pupils who will take metalwork was only an estimate based on current enrolments and pupil choices. Future changes in the

number of pupils wishing to take metalwork could considerably change the unit cost.

(d) Practical Subjects Compared with Other Subjects

As mentioned above, unit costs in practical subjects are usually higher than in other subjects. Four reasons for this are: (i) practical subjects require more expensive buildings and equipment, (ii) they are usually taught in smaller classes, (iii) teachers of technical subjects often attract higher salaries than other teachers, and (iv) teachers often have to be supported by technicians and other personnel.

More explanation of these points is given in Part II of this book. Meanwhile, Figure 3.1 shows a possible range of unit costs in different subjects. Unit costs are much higher in practical subjects than in English, social studies, religion, etc.. And Table 3.1 shows comparative capital costs of different practical subjects in a typical secondary school.

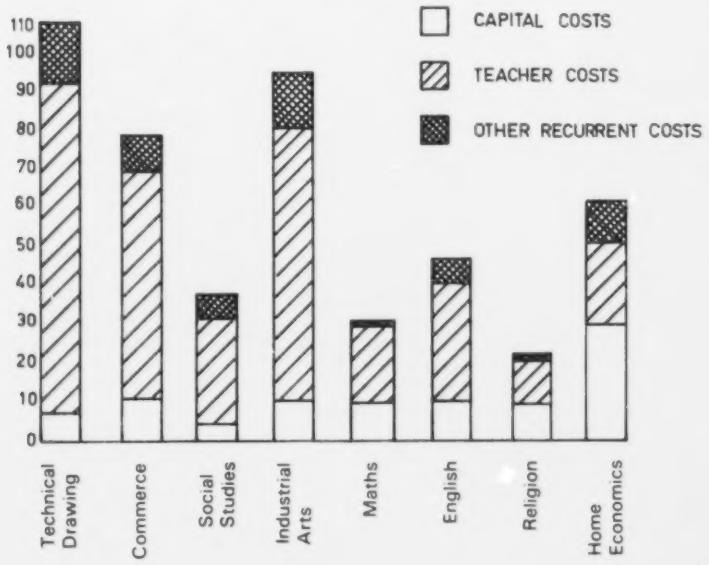


Figure 3.1: Unit Costs, by Subject

Table 3.1: Capital Costs of Workshop and Classroom Places at New Wotton School, Barbados, 1986 (US$)

	Workshop Cost	Places	Cost/ Place	Amortised Cost/Place
Woodwork				
Construction (100 sq.m.)	84,900	20	4,246	467
Furniture	6,540		327	43
Equipment	20,000		1,000	160
Total	111,440		5,573	670
Metalwork				
Construction (100 sq.m.)	84,900	20	4,246	467
Furniture	6,540		327	43
Equipment	30,000		1,500	240
Total	121,440		6,073	750
Basic Auto				
Construction (120 sq.m.)	101,900	20	5,095	560
Furniture	7,840		392	51
Equipment	25,000		1,250	199
Total	134,740		6,737	810
Electrics/Electronics				
Construction (80 sq.m.)	67,900	20	3,395	374
Furniture	5,230		262	34
Equipment	15,000		750	120
Total	88,130		4,407	528
Technical Drawing				
Construction (90 sq.m.)	76,400	30	2,547	280
Furniture	5,880		196	26
Equipment	9,000		300	55
Total	91,280		3,043	361
Science				
Construction (90 sq.m.)	76,400	30	2,547	280
Furniture	5,880		196	26
Equipment	13,500		450	72
Total	95,780		3,193	378
Classroom Subjects				
Construction (54 sq.m.)	45,900	30	1,530	168
Furniture	3,530		118	17
Total	49,430		1,648	185

The figures in Table 3.1 may be used to calculate the cost of replacing one student-hour of ordinary academic classroom teaching by one student-hour of vocational teaching. The following assumptions are made:

— students spend seven hours per day in school;
— class size for ordinary lessons is 30;
— class size for workshops and laboratories is 15;
— teachers are fully utilised.

The conversion of one hour per day of classroom teaching into one hour of practical teaching requires one additional teacher for one-seventh of the day (because two practical teachers are required for two groups of 15 students instead of one classroom teacher). The marginal capital and teacher costs for each type of workshop and for science laboratory work are given in Table 3.2. The marginal costs for practical subjects (excluding science) average at US$148. This represents an increase of about 10-11% on the total unit cost for secondary education ($1,439).

Table 3.2: The Cost of Vocationalising Education in New Wotton School, Barbados, 1986 (US$)

	Amortised Cost/Place	Amortised Cost ÷ 7	Classroom Cost	Marginal Cap. Cost	Instructor Cost	Total Cost
Woodwork	670	96	26	70	85	155
Metalwork	750	107	26	81	85	166
Basic Auto	810	116	26	90	85	175
Electricity	528	75	26	49	85	134
Tech Drawing	361	52	26	26	85	111
Science Lab	378	54	26	28	85	113

(e) Computers for Cost Analysis

Most costs can be effectively analysed with a simple calculator. However, planners who want more complex and detailed analysis should use a computer. A simple programme called the 'Economics of Curricular Choice' is readily available. It can be used either on an IBM PC (using the Lotus 1-2-3 package) or on a Macintosh (using the Excel

package). The programme may be obtained from:

The Economic Development Institute,
The World Bank,
1818 H Street, N.W.,
Washington DC 20433,
USA.

Part II: Making Efficient Use of Expensive Components

4. Special Buildings

(a) Why Costs are High

Practical subjects require such special accommodation as:

— workshops for woodwork, metalwork and electricity,
— drawing rooms for technical drawing,
— commerce rooms for typing and business studies,
— home economics rooms for cooking, home management and tailoring/needlework, and
— sheds for agricultural science and animal husbandry.

Sheds are likely to be quite cheap to construct, but the others are likely to be expensive. The reasons for this are:

* *Space*: Specialist rooms must allocate more space per pupil than ordinary classrooms. This is because (a) the pupils need to be able to move, (b) the rooms need to hold specialist equipment, and (c) the rooms must store both raw materials and finished products.
* *Structure*: Workshops often need floors that can hold heavy machinery. They may also have special lighting, temperature, humidity and dust-proofing requirements.
* *Facilities*: Workshops and home economics rooms must have electricity and gas. They also need both supplies of water and systems for drainage or disposal.

The Costs of Buildings for Different Subjects

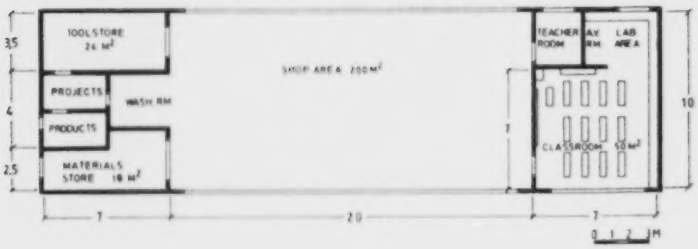
The two main determinants of unit building costs are the nature of the building and the space allocated per student. The following table summarises one plan for space allocations and costs in Trinidad & Tobago.

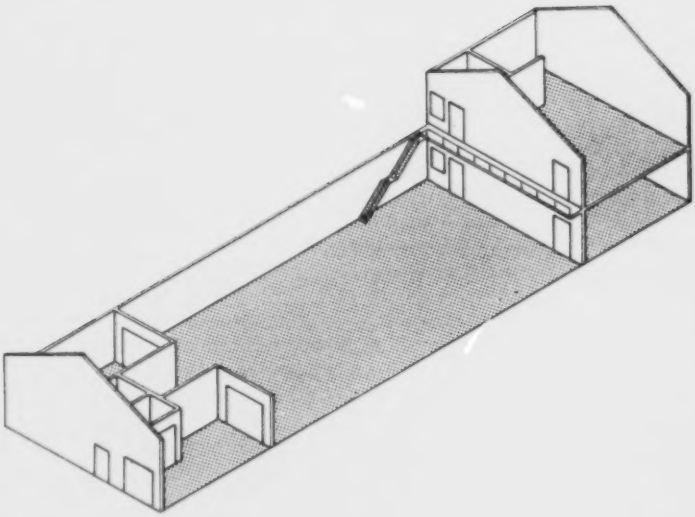
	Square Feet per Student	*Cost per Square Foot (US$)*	*Amortised Cost per Student (US$)*
Home Economics	*255*	*18.80*	*96.1*
Automechanics	*216*	*11.00*	*47.5*
Electrical	*204*	*10.00*	*41.0*
Carpentry & Joinery	*200*	*11.20*	*45.0*
Machine & Metals	*200*	*11.24*	*44.8*
Business Studies	*192*	*20.80*	*80.0*
Agricultural Science	*168*	*25.00*	*84.0*
Technical Drawing	*162*	*10.00*	*32.4*
Masonry	*86*	*21.60*	*37.4*

(b) How Cost-Effectiveness can be Improved

The costs of buildings can be reduced in the following ways:

- *Multipurpose Buildings*: One building can be constructed e.g. to serve the sciences, woodwork, metalwork and home economics. Benches, tables, electricity sockets and gas outlets can be moved as required. Two such designs are shown on pages 32 and 35. Movable partitions help increase flexibility.
- *Designs for Specific Schools*: Some designs may look nice on paper, but may not suit the needs of specific schools. Planners should obtain local advice in each case by consulting the teachers and local administrators. They should remember to allow for future school expansion or contraction.
- *Materials and Contractors*: In general, use of local materials and contractors will save costs. Sometimes, however, administrators must be cautious: local materials may not be long-lasting, and local contractors may do poor work.





A Multipurpose Workshop Design recommended by Unesco

* *Awareness of Future Technical Needs*: Designs must take account of the specific demands that will be placed on the buildings. In one school known to the author, welding machines requiring high rating electrical power have never been installed because the cost of rewiring the workshop is prohibitive.

In addition, buildings can be used more efficiently:

* *Intensive Use*: Unit costs can be reduced if buildings are used intensively:
  - — class sizes can be adjusted to the optimum level,
  - — lessons can be held at lunchtimes and in the evenings,
  - — adult education classes can be held in the schools during the evenings, weekends and vacations, and
  - — all students can be required to take particular subjects; e.g. both sexes could be required to take woodwork and/or tailoring.
* *Proper Use*: At the same time, buildings should be used for the specialist purpose for which they were designed. Theory subjects can be taught as easily in a classroom as in a workshop. If the workshop would otherwise be empty, then they can be taught in the workshop; but if another class would use the workshop for practical subjects, the theory should be taught in a classroom.
* *Specialist Schools*: Alternatively, schools can specialise in one or a few subjects. Expensive equipment can then be concentrated in one centre.
* *Sharing Resources*: Expensive buildings need not be constructed in every school: they may be placed in one school and shared by others. However, this is only feasible when schools are close together and students can travel easily and cheaply.

Sharing Buildings among Schools: The Advantages and Disadvantages

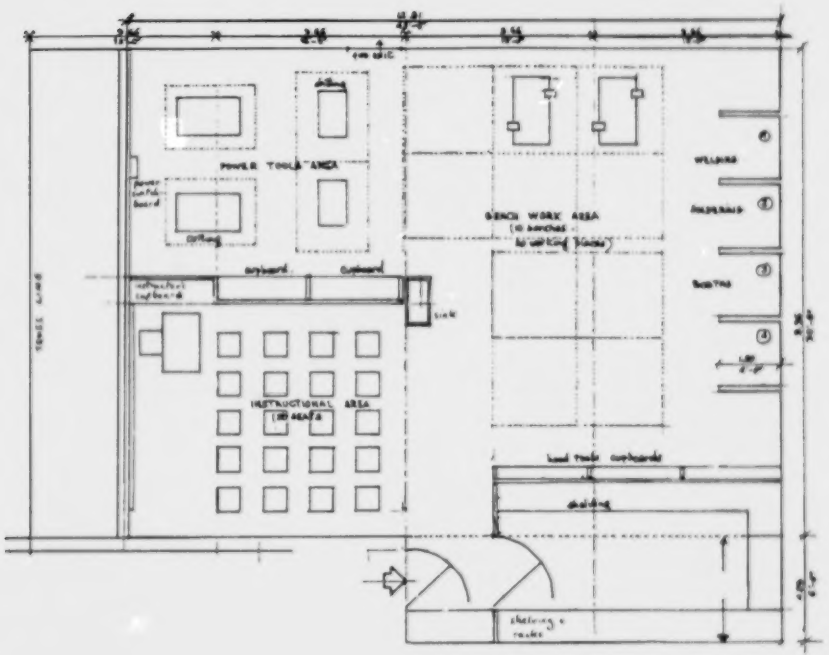
The main advantage *of schemes to share buildings is that they save construction costs. Only one central school needs to have the buildings, and the others share.*

The main disadvantages *are:*

- *If the teachers are based in the central school, they may find it hard to get to know all pupils and to enforce discipline; but if all schools have their own specialist teachers, they have to teach other subjects to be fully occupied.*
- *The host school may find itself paying for damage caused by pupils from other schools.*
- *Timetabling becomes very complicated.*
- *Students have to spend a lot of time on travel.*
- *Travel may be so costly that nothing is saved by the scheme.*
- *Pupils may not identify so strongly with their own schools, and loyalty may be hard to build.*
- *Pupils may feel that practical subjects are not part of ordinary school life.*

However, school cluster schemes have been operated successfully in Barbados, Costa Rica, India, Thailand and Sri Lanka, for example. Administrators usually find it most cost-effective for students to spend a whole morning or afternoon (or even a whole day) in the host school rather than to send them for individual teaching periods.

A Multipurpose Metal Workshop used in Dominica



5. Furniture & Equipment

(a) Why Costs are High

Practical subjects also need specialised furniture & equipment:

- *Home Economics*: cupboards, cookers, refrigerators, kitchen equipment and utensils.
- *Needlework/Tailoring*: sewing machines, clothes-making accessories.
- *Woodwork*: benches, vices, saws, hammers, chisels, etc..
- *Metalwork*: benches, vices, lathes, hand and power tools.
- *Agricultural Science*: agricultural machinery and tools.
- *Commercial Subjects*: computers, typewriters, calculators.
- *Technical Drawing*: drawing boards and instruments.

In many countries, most of these items have to be imported. And even when locally made materials are available, imported goods often have higher prestige. Schools sometimes find that a desire for prestige forces them to buy equipment that cannot be justified on other grounds.

In addition, many schools in developing countries are too remote to have mains electricity supplies. They therefore need their own generators which, if they are to run metalwork and other machinery, must be quite powerful. And even when schools do have mains electricity, many find that they need (a) power stabilisers to protect computers and other expensive equipment from surges, and (b) stand-by generators for use during power cuts.

A further problem is that technologies often develop rapidly, so that schools find that their equipment is out of date. Schools with computers, for example, have found this a major problem.

Schools often find that they need special vehicles, e.g. to carry agricultural produce or items made in metalwork shops. In many countries, these vehicles also need to be imported.

Finally, because equipment is costly, schools must take precautions against theft and accidental damage. All buildings require strong locks and fire-fighting equipment, etc..

The Costs of Equipment in Different Subjects

A 1982 analysis of unit costs in Trinidad & Tobago led to the following estimates of annual equipment costs per student (amortised and expressed in US$):

Machine & Metals	*40.0*
Automechanics	*37.3*
Carpentry & Joinery	*23.3*
Electrical	*20.6*
Home Economics	*20.0*
Business Studies	*18.6*
Agric. Science	*17.3*
Masonry	*12.6*
Technical Drawing	*8.0*

As the table shows, equipment costs in machine & metals were five times as high as those in technical drawing. Technical drawing also had the lowest building cost per student (see Chapter 4). The subject with the highest combined building and equipment cost was home economics.

(b) How Cost-Effectiveness can be Improved

Because buildings and equipment go together, many of the points raised in Chapter 4 are also applicable here:

- Schools can try to use furniture and equipment for different purposes, e.g. benches for both woodwork and metalwork, gas for both laboratories and general kitchens, etc..
- Locally made equipment can be used wherever possible — perhaps constructed in the school itself.
- Schools can try to share resources.
- The curriculum can be adapted to focus on topics that do not require costly equipment.
- Equipment that is only needed occasionally can be (i) shared between schools or (ii) borrowed or hired from commercial

enterprises. Hiring may also be desirable when equipment needs frequent servicing, and when it is likely to become rapidly outdated.

Furniture

Traditional, large, heavy fixed benches are not recommended. They are costly to construct, consume a great deal of material, and the drawers and cupboards which are commonly made part of the construction are rarely used for the purposes for which they were designed. Once in position, the benches remain there for ever.

Instead, benches should reflect the flexible demands of different needs. They should be easily movable, so that they can be cleared away and joined together as desired. A useful dimension is 5 feet (1.5 metres), which allows two students to sit side by side. An edge overhang of three inches (7.5 cms) permits easy use of edge clamps.

Instead of a fixed demonstration bench, a trolley bench or cart can carry apparatus, materials and water. The trolley can be loaded from a central storeroom or cupboard, and then moved into position between benches. Figure 5.1 shows a picture of one.

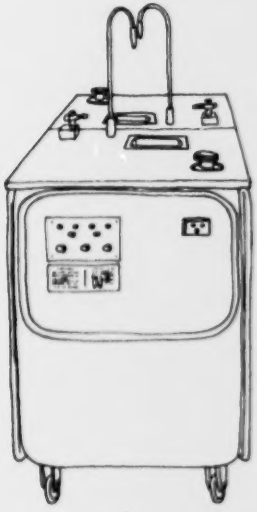


Figure 5.1: A Movable Trolley to Carry Water, Gas and Materials

Storage

Many schools suffer severe storage problems. Unsuitable layouts waste space and cause costly breakages.

The best storerooms avoid expensive adjustable shelving but do have a variety of different shelf widths and heights. Heavy items are stored at low levels, and corrosive substances are stored in their containers in a bed of sand at floor level. There are separate areas for storing tools, equipment, raw materials, and products. Often it is desirable to store dangerous equipment and materials separately.

The total storage area should generally be not less than one fifth of the workshop or practical area.

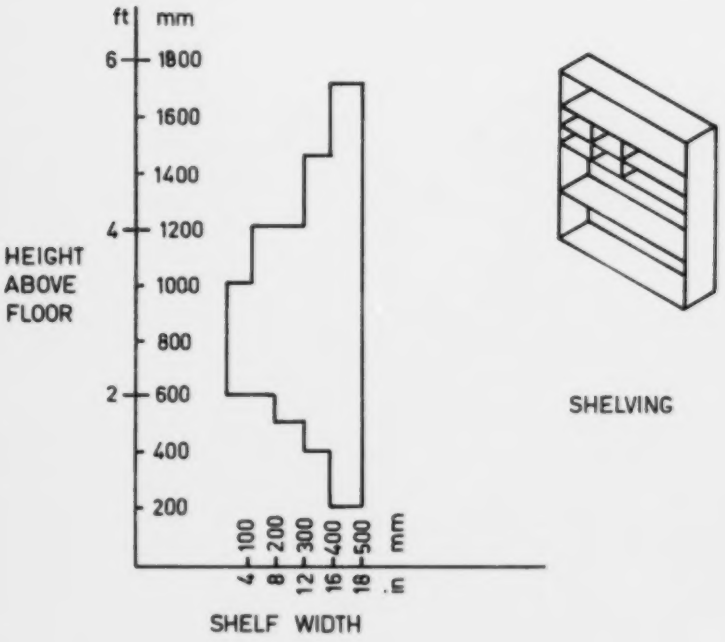


Figure 5.2: A Recommended Design for Storage Shelves

6. Curricula & Examinations

(a) Why Costs are High

Under this heading, the main factors that make practical subjects expensive are:

i) excessive choice of options within individual schools, which leads to low student numbers in particular subjects;
ii) a mix of theory and manual work that makes poor use of expensive facilities;
iii) a syllabus that requires schools to buy costly machinery and materials;
iv) administrative overheads for public examinations that have to be spread over a small number of candidates; and
v) an examination process that has to place strong emphasis on practical work, which in turn requires complex administration.

In the Caribbean context, the impact of the fourth and fifth factors can be seen by comparing unit costs for Caribbean Examination Council (CXC) subjects (Table 6.1). Only the large entry subjects such as bookkeeping, mathematics and English had reasonably low unit costs.

(b) How Cost-Effectiveness can be Improved

(i) The Number of Subjects

When deciding how many subjects to offer, the authorities have to balance two competing factors. On the one hand job opportunities, local relevance, and education in its broadest sense might demand a very broad curriculum with many subjects at all levels; but on the other hand the need to control costs may require some restrictions.

The first step in decision-making is for individual schools to work out costs for individual subjects. This requires estimation of workshop utilisation rates, teacher utilisation rates, and class sizes. All of these are fairly easy to survey.

Table 6.1: Unit Costs in CXC Subjects, 1985

Subject	Entries	Examiners	Direct Cost per Candidate
Bookkeeping & Accounts	12,442	42	$35.05
Mathematics	28,873	139	36.46
English	37,817	211	38.11
Typewriting	5,362	40	52.20
Food & Nutrition	2,551	17	61.10
Technical Drawing	2,791	11	70.10
General Electricity	915	6	100.30
Woods	870	5	101.20
Home Management	817	4	103.00
Agricultural Science	2,035	19	110.40
Metals	716	5	118.40
Shorthand	545	2	133.70
Clothing & Textiles	718	6	140.00

Taking just the example of workshop utilisation rates, if the authorities found a pattern like Table 6.2, they would be worried. The classrooms and laboratories are well used, but the workshops are poorly used. To improve the situation, they could:

— adapt the workshops (as discussed in Chapter 4) to serve more than one subject, and/or
— try to increase overall student numbers in practical subjects, and/or
— restrict the range of the curriculum, to increase utilisation of workshops for individual subjects.

In this example, the authorities might not save much from *closing* workshops since the facilities have already been built and would probably lie idle. However, calculations can be done in reverse if the authorities are considering an increase in the range of subjects offered, and want to know whether to *construct* a room.

If, for example, they wanted to offer commerce, they would have to calculate (a) the demand that would exist for a specialist commerce room, and (b) the extent to which the new subject would *reduce* utilisation of the existing facilities. They would then be able to decide whether construction of a commerce room would be justified.

Table 6.2: Example of a School's Facilities Utilisation Rates

	Total subject periods in one week	Classrooms/ Workshops Required	Use Factor
Classrooms	167	6	93%
Laboratories	24	1	80%
Workshops:			
Automechanics	12	1	40%
Machine Shop	12	1	40%
Electrical Shop	12	1	40%
Dressmaking/Tailoring	12	1	40%
Food/Nutrition	12	1	40%
Home Economics	11	1	36%
Woodwork	11	1	36%
Metalwork	11	1	36%
Technical Drawing	6	1	36%
Agricultural Science	6	1	20%

Note: Use factors are calculated on the assumption that there are 30 periods in a week.

(ii) The Balance between Theory and Manual Work

If curricula are determined by central examination boards, individual schools have little scope for altering the balance between theory and manual work. However examinations boards themselves, and schools which are less constrained by public examinations, may find it useful to consider the balance.

Once again, authorities would have to consider two constrasting forces:

— On the one hand, theory work can be done in a classroom and with larger student numbers. Also, it uses fewer raw materials (gas, electricity and practical materials). As such, unit costs can be lower than for manual work.
— On the other hand, there is a danger of too much theory defeating the whole purpose of the subject. Students *must* do adequate manual work to become properly skilled. Although some theory is essential, it cannot be allowed to become too dominant.

(iii) The Content of the Syllabus

Periodic scrutiny of the syllabuses of practical subjects is always necessary — both by individual schools and by examinations boards. For example, should home economics predominantly teach students how to operate a Western-style home (perhaps with an electric cooker), or should it emphasise local styles (using a charcoal or kerosene cooker)? The decisions taken affect not only the relevance of the curriculum but also its costs. The latter can be reduced if the syllabus emphasises cheap and locally available materials.

(iv) Examination Overheads

Examination boards have to take their own decisions about the breadth of subjects that they can offer. They have to balance the costs against the priorities of the nation. If the latter are sufficiently pressing, they may be able to get a subsidy from the government. If the government is unable to grant a subsidy, the boards may simply have to drop the subjects from their lists.

To avoid the latter, however, there are some ways to improve efficiency:

— small numbers of candidates may be grouped in a central institution for examination purposes;
— local assessors can be recruited to examine pupils in their own areas, and
— project work can be assessed in the schools themselves (and perhaps *by* the schools themselves), to avoid transportation to a central place.

Because practical examinations are costly to run, during times of financial stringency there is a danger of them being cut out altogether. This is clearly undesirable. Abolition of practical examinations might reduce costs, but it would severely damage effectiveness.

Two Examples of Caribbean Examinations Council Procedures

1. Agricultural Science

Amount of Practical Work Required: *School Based Assessment: 25%*
Final Exam: 10%

School Based Assessment:

a) student performance in the field and laboratory on 21 skill objectives made over the 2-year period of the course.

b) 3 aspects of Farm Record Books and 1 assessment on Practical Notebook at the end of the 5th term.

Visiting Assessors: *Specialists in agriculture informally moderate teachers' marks by periodically assessing candidates.*

Visiting Moderator: *A CXC-appointed specialist reassesses candidates' Farm Record Books and Practical Notebooks.*

Practical Examination: *A written examination. Ten displays are set up. Candidates required to identify specimens visually and to answer questions based on situations presented visually with the aid of photographs, diagrams or live specimens.*

2. Shorthand & Typed Transcription

Amount of Practical Work Required: *School Based Assessment: 30%*
Final Exam: 70%

School Based Assessment:

During Term 4, students are given 5 assignments. Dictation and marking done by teachers according to mark scheme provided by CXC.

Teachers' marks and grades for candidates submitted to CXC. The work of a sample of candidates identified by CXC is used in the external moderation of teacher marks.

Marks are moderated against the candidate's performance in the final examination.

Practical Examination:

This is set in 2 parts: a) Dictation: 3 assignments varying in length and speed.
b) Transcription of the dictated passages.

7. Teachers & Support Staff

In any education system, salaries are the largest item in the recurrent budget. This chapter discusses the salaries and utilisation of (1) specialist teachers, (2) specialist support staff, and (3) administrators.

1. Teachers

(a) Why Costs are High

As well as having good teaching skills, the best practical teachers have work experience in large or small scale industry. Such people are hard to recruit, however. Rather few people have *both* good teaching skills *and* good industrial experience; and the ones who do exist often earn much more money in the private sector, and so are unwilling to teach.

This is the first factor that makes practical teachers expensive. Governments have to offer high salaries and other inducements to persuade them to join the profession.

The second factor arises from training. Because practical teachers have to learn both how to teach and how to become good craftsmen, their training is often longer than that of other teachers. And teacher-trainers for practical subjects are even more scarce than teachers themselves. Again, governments often have to pay special inducement allowances; and sometimes they have to recruit from overseas.

The third factor arises from pupil:teacher ratios. For both safety and educational reasons, classes in practical subjects are usually smaller than ones in academic subjects. Costly staff are therefore being used to train smaller groups of students.

(b) How Cost-Effectiveness can be Improved

Several strategies can be used to maximise the effective use of specialist teachers:

Training

* Require teachers who are being trained to gain skills in at least two subject areas (e.g. woodwork *and* metalwork, home

economics *and* needlework).
* Reduce costs of long pre-service training by providing in-service and on-the-job training.

Deployment
* Where possible, use specialist teachers only for specialist subjects. Do not 'waste' their time on subjects for which other staff can be hired more cheaply.
* If an individual school's demand for specialist teachers is too low, either:
  — share specialists between schools, or
  — employ part-time staff.
* Within the limits imposed by safety requirements and teaching effectiveness, increase the size of teaching groups. Workshop sessions may need to be with small groups, but theory classes can be much larger.
* Request the teachers to help with maintenance and construction of facilities for which the school would otherwise have to pay outside workers.

Alternative Personnel
* Employ ancillary staff for general routine jobs. This leaves the teachers free for teaching.
* Provide self-instructional materials for the students. and request the senior students to supervise the junior ones.

Many governments make teaching more attractive by allowing technical staff to undertake private work out of school hours and in vacations. Such policies have to be handled with care, however, Sometimes teachers spend too much time on private businesses, and neglect their lessons.

2. Specialist Support Staff

(a) Why Costs are High

Workshops often require technical support staff. The wages of these staff are not especially high, but they add significantly to the overall cost of practical subjects.

The duties of technical support staff are usually to:

— keep the workshops tidy,
— clean and store equipment after use,

— unpack and inspect new equipment on arrival,
— maintain and, if possible, repair equipment,
— look after the general storage area,
— keep records of equipment and stock, and order more when required,
— prepare materials for use in the practical rooms,
— set out the rooms in readiness for classes, and
— help prepare visual and other teaching aids.

Besides technical staff, it may be necessary to employ night watchmen, and, for agricultural science, farm hands. These people can usually be employed on low wages; but if several are employed, their total salary costs can be quite large.

(b) How Cost-Effectiveness can be Improved

Some governments provide special training for technical support staff. This increases costs, but it may also increase their effectiveness and be a good investment.

At the same time, authorities can seek ways to reduce costs by:

* sharing staff between institutions, and
* requiring students to do the work.

The additional advantages of requiring students to do the work are (i) that it helps develop a sense of responsibility, and (ii) that it encourages good work habits.

3. Administrators

(a) Why Costs are High

Practical subjects may require considerable administration:

— workshops have to be maintained, and bills have to be paid,
— materials have to be ordered and stored,
— extra staff must be recruited and paid,
— complicated timetables must be worked out,
— complex practical examinations must be administered,
— attachments to outside industries must be organised,
— schools that share resources must liaise with each other.

Often, these duties can be done by existing staff; but sometimes

Job Specification for a Workshop Attendant: Trinidad & Tobago

Kind of Work

Routine semi-skilled work in the care and maintenance of working machinery and equipment.

Examples of Work

- *Issues tools and instruments for use by students and instructors, and receives same after use.*
- *Improves tool displays, and assists in the preparation of machines, equipment, solutions and other related materials for demonstrations.*
- *Reconditions, cleans and assists in repair of tools and equipment.*
- *Maintains an inventory of all tools, and reports and records all defects in machinery and equipment.*
- *Prepares requisitions for hand tools and consumable materials, ensures that adequate stock is always available.*
- *Performs related work as may be required.*

Required Knowledge, Skills and Abilities

Some knowledge of workshop methods and practices.

Some knowledge of machinery, equipment, tools and other materials used in the relevant trades.

Ability to follow simple written and oral instructions.

Ability to establish and maintain effective working relationships with other employees and with students.

Minimum Experience and Training

Experience in the relevant trade, gained e.g. as an apprentice, and training as evidenced by the Intermediate City & Guilds Certificate or Part I of the Trinidad & Tobago National Craft Diploma in the particular trade; or any equivalent combination of experience and training.

the introduction of practical subjects requires recruitment of extra administrators.

(b) How Cost-Effectiveness can be Improved

The main need is for an administrative system that operates smoothly and efficiently. Two strategies may be particularly useful:

* provide appropriate in-service training, and
* ensure that administrators have incentives to be efficient.

The incentives should include recognition by the authorities, and ability to retain saved income at the school level.

8. Teaching Materials

(a) Why Costs are High

All subjects, of course, need some teaching materials — textbooks, exercise books, chalk, wall charts, etc.. But practical subjects generally need more materials than other subjects. For example:

— *Home Economics* requires food, cleaning materials and water;
— *Needlework/Tailoring* requires cloth, thread and needles;
— *Horticulture* requires seeds, fertilisers and sacks;
— *Animal Husbandry* requires young animals and food;
— *Secretarial Studies* require typing and carbon paper, computer disks and general stationery;
— *Automechanics* requires spare parts, grease and fuel;
— *Metalwork* requires the basic metals, solder, etc.; and
— *Woodwork* requires the basic woods, varnishes, glues, etc..

An extra cost in all cases arises from transportation. This is particularly serious for small and remote schools.

The usual methods for obtaining materials are outlined in the following checklist:

Method	Requirements
a. Private suppliers select and import educational equipment and distribute it to schools through their own channels.	Adequate foreign exchange and unrestricted import; substantial funds under the control of/allocated to schools.
b. Private suppliers arrange for some local manufacture and only import items that cannot be made locally.	Adequate foreign exchange and an equipment-oriented local manufacturing industry. Equipment funds for individual schools.

c. Selected small-scale private industry is able to design and manufacture according to specifications, and distributes to local schools.	A well-developed local small-scale industry with a good distribution network. Equipment funds for individual schools.
d. Design, manufacture and distribution is managed by the Ministry of Education with assistance from local or foreign industries.	A government-operated equipment and materials centre with designers, technicians, and storage/packing facilities.
e. Low-cost teaching aids are made by the teachers and students.	Design and manufacturing instructions; tools, facilities and time; enough funds at the school level; incentives.
f. Materials are supplied by foreign aid achemes.	Storage and distribution system; method for selecting recipient schools within the system.

(b) How Costs can be Reduced

The two main ways to reduce costs are by (i) bulk purchase, and (ii) use of local materials.

(i) Bulk Purchase

In some systems, the government arranges bulk purchase and distribution. Sometimes this effects dramatic savings. In Jamaica, for example, a ream of paper normally costing $45.00 through a retailer can be obtained from the Central Purchasing Agency for just $18.00.

Other countries have no such government-organised systems; but schools can take their own initiative to group together and make bulk orders. In this way, they obtain discounts from larger orders, and reduce the costs of transportation.

Bulk purchasing has disadvantages as well as advantages, however. The situation may be summarised as follows:

Advantages of Bulk Purchasing:

— It offers opportunities for considerable savings, particularly if

Costs of Materials: A Comparison of Different Subjects

One school in Jamaica has analysed the costs of materials for each student in each subject. The table below summarises its findings for students in Grade 10 and in the Vocational 1 stream. It shows a wide variation, with physics and electricity as the most expensive, and general class subjects as the least expensive.

Subject	*Annual Cost of Materials per Student (US$)*
Physics	*25.20*
Electricity	*25.20*
Machine Shop	*21.40*
Home Economics	*20.00*
Automechanics	*16.60*
Building	*15.00*
Engineering	*15.00*
Carpentry & Joinery	*15.00*
Nutrition & Cookery	*10.00*
Dressmaking & Needlework	*10.00*
Commercial Practice	*7.60*
Art & Craft	*4.60*
Chemistry	*4.40*
Business Studies	*4.00*
Typewriting	*3.60*
Biology	*3.00*
General Class Subjects	*3.00*

competitive tendering/bidding is provided for.
— It facilitates standardisation of equipment among schools.
— It requires administrators to think ahead.

Disadvantages of Bulk Purchasing:
— It cannot be implemented in emergency situations.
— It is sometimes associated with delays in delivery, especially when

orders are from overseas.
— It is likely to require substantial storage facilities and personnel to monitor stock movements etc..

(ii) Use of Local Materials

Materials produced within the country are usually cheaper than imported ones; and sometimes schools can obtain very cheap materials from their own neighbourhoods. For example:

— Scrap merchants may have spare parts for automechanics and metals for metalwork;
— Sawmills can supply off-cuts for woodwork and for fuel in domestic science;
— Builders' yards can supply bricks and cement;
— Pottery-makers can supply glazing materials and mica, and
— Printers can supply coloured cards and paper.

Purchase of Locally-Available Materials

A great many useful materials for practical subjects can be purchased locally at low cost. They include:

Aluminium sheets	*Mosquito mesh*	*Sandpaper*
Ball-bearings	*Nails and tacks*	*Screws*
Balloons	*Needles*	*Sealing wax*
Bicycle inner tube	*Nylon fishing line*	*Staples*
Bicycle spokes	*Paint brushes*	*Steel wool*
Candles	*Paper clips*	*Straws*
Cardboard	*Paper or plastic cups*	*String*
Clothes pegs	*Pipe cleaners*	*Thick wire*
Curtain rings	*Plastic bags*	*Thin wire*
Electrical wiring	*Plastic sheets*	*Tin plate*
Electronic parts	*Plastic tape*	*Thread*
Hooks	*Plastic tubing*	*Various glues*
Marbles	*Polystyrene foam*	*Wooden beads*
Metal tubing	*Razor blades*	*Wooden dowelling*
Metal foil	*Rubber bands*	*Wooden sticks*

9. Maintenance, Repair & Replacement

(a) Why Costs are High

Although maintenance and repair of specialist buildings and equipment is extremely important, it is a notorious weakness in many systems. Ineffective maintenance and repair systems increase overall costs in three main ways:

— buildings and equipment suffer from reduced life spans,
— teaching is disrupted by breakdowns, and
— broken materials occupy valuable storage space.

It is not uncommon for schools to have 'graveyards' of expensive equipment that has been allowed to deteriorate simply because of inadequate maintenance and repair. And sometimes badly maintained equipment is dangerous to its users.

Equipment that has been donated by aid agencies is often particularly problematic. Frequently, the equipment is made in the country of the agency that donates it, and neither the necessary expertise nor the spare parts are available locally. Also, many aid projects only provide the equipment itself, and make no financial provision for subsequent maintenance.

(b) How Cost-Effectiveness can be Improved

Eight strategies are particularly useful:

i) *Finance*: Make sure that every school/local authority has a budget allowance for maintenance, repair and replacement.

ii) *Standardisation*: As far as possible, use commonly available equipment, which can easily be repaired in the neighbourhood, and for which spare parts are readily available. If equipment

Financial Allocations for Running Costs: A Rule of Thumb

Although it is impossible to devise a rigid formula, a useful 'rule of thumb' on running costs may be highlighted. It is that 10% of the basic cost of equipment should be set aside each year for (i) consumables, (ii) maintenance and repair, and (iii) consumption of water, electricity and gas.

For example, if a school allocates $5,000 for equipment in a home economics room, it should also allocate $500 each year for running costs.

Clearly this rule has to be treated cautiously, and individual authorities should work out their own requirements in their own situations. However, it does provide a starting point. Too many projects run into major trouble because they budget only for capital works and completely forget about running costs.

donated by aid agencies is problematic, make sure that the agencies understand the difficulty.

iii) *Expertise of Technical Staff*: Make sure that teachers and support staff know how to maintain equipment. Provide relevant pre-service and in-service training courses.

iv) *Incentives*: Make sure that schools have an incentive to maintain and repair equipment. Penalise institutions that fail to maintain equipment, and reward the ones that do. Penalties and rewards can be financial or verbal (e.g. praise or criticism in public speeches), and can affect the promotion opportunities of the people concerned.

v) *Student Attitudes*: Breakdowns are often caused by pupil disregard for correct behaviour, and even by student vandalism. The authorities need to be alerted to the consequences of this type of attitude, and appropriate rewards and penalties need to be implemented.

vi) *National or Regional Centres*: Establish national or regional equipment centres to repair equipment. Either (i) require schools to bring equipment to the centres, or (ii) require staff from the centres to travel round the schools. The latter strategy encounters problems in carrying equipment and spare parts, but it avoids the danger of the schools' equipment being damaged again on its way back from the centres to the schools.

vii) *Contracts with Local Businesses*: If governments do not wish to set up special centres, they can instead make arrangements with local businesses. As with the centres, either (i) schools bring equipment to the technicians to be repaired, or (ii) the technicians travel round the schools.

viii) *Disposal of Useless Equipment*: If broken equipment is really useless (i.e. cannot even be used as raw material in metalwork classes, etc.), it should be disposed of. Otherwise, it occupies storage space and increases costs further. Improvement of methods for disposal may require review of regulations and delegation of responsibility to individual school principals.

Where governments are faced with the choice of (i) requiring schools to do their own maintenance, (ii) setting up government maintenance and repair centres or (iii) giving a contract to a private company, they should weigh up the following factors:

- Special centres or agencies may be efficient, but their existence reduces the burden on the schools themselves. Staff and pupils could become careless because they know that someone else is always available to repair damage and pay bills.
- Specialist agencies are more likely to have skilled personnel, and to have access to spare parts.
- Private businesses can manipulate the availability of spare parts to their advantage (e.g. if later models come on to the market). Also, they may try to make extra profits by replacing parts that do not really need replacing.
- Government enterprises do not always work well. In some countries they have a reputation for inefficiency and communication problems.
- If the authorities have a contract with one particular business,

they may be unable to secure independent outside help during an emergency.

* When all work is done by a centralised agency, it becomes easier to compare schools with excessive wear and breakage because of faulty instruction or weak discipline.

An Example of a Centralised Service Agency

The Maintenance Training & Security (MTS) company in Trinidad & Tobago provides a centralised service for schools and other government institutions. The Permanent Secretary of the Ministry of Education is a member of the Board of Directors, but financial arrangements are controlled by the Ministry of Works.

The company's services include:

- *building and plant maintenance,*
- *janitorial maintenance,*
- *grounds maintenance,*
- *security, and*
- *maintenance of instructional equipment.*

The company also undertakes investigations into the causes of equipment failure, and arranges for substitute equipment if necessary while an item is being repaired.

Part III:
Generating Extra Resources

10. Students' Fees

One common way to meet the high costs of practical subjects is to charge fees. These can be:

- — specific ones for individual subjects (e.g. $10 per term for woodwork, but $12 per term for automechanics);
- — specific for particular levels (e.g. $11 per term for all students in Form 3 but $13 for all students in Form 4);
- — flat rate ones for all students in any particular school; or
- — flat rate ones for all students in the system.

Some fees are quite low, and just attempt a small reduction in the total financial burden; others are quite high, and are nearer the real cost of education. And some private schools actually seek to make a profit on fees.

(a) Advantages

The main advantages of fee-charging systems are that:

i) The people who will benefit from the service are the ones who pay the fees. This contrasts with general government taxes, which people have to pay whether they benefit from specific government services or not.

ii) They encourage students and their families to be more cost-conscious, less wasteful of the opportunities to learn and of the

materials provided.

iii) They encourage students and their families to make more careful choices about the subjects they study, and to avoid waste of time and resources learning skills that they are unlikely to use.

(b) Disadvantages

The main disadvantages of fee-charging systems are:

i) They may discriminate against poor families and thus maintain social inequalities;
ii) They may encounter strong political opposition;
iii) Because practical subjects are more costly than academic ones, they may reduce demand for practical subjects. This would (a) prevent achievement of some social goals, (b) perpetuate an irrelevant curriculum, and (c) reduce student numbers for some courses to such a low level that the courses could not be offered.
iv) When fees are low, the costs of collection severely reduce the amount gained.
v) When individual institutions have to collect the fees, (a) the staff members' time is consumed, and (b) the risk of embezzlement increases.
vi) Fees which increase at different stages of the system also increase the likelihood of students dropping out before the end of their courses.

One solution to these problems is a scholarship or bursary system. Such a system can be operated either by the government or by institutions themselves. However, authorities must be wary of the administrative costs of scholarship schemes.

11. Sale of Goods & Services

Another way to generate extra resources is through sale of goods and services. These can be:

* on an *ad hoc* basis, i.e. the school sells the products as and when they are produced, or
* on a contract basis, in which the school undertakes in advance to supply a certain amount of produce at an agreed price.

(a) Scope

The types of projects on which a school may embark are almost unlimited. The following are a few examples. Schools may:

— sell crops and animals as soon as they are matured;
— run their own trade stores;
— service and repair vehicles;
— make furniture for sale;
— go to people's homes and farms to mend fences, etc.;
— make clothes for sale;
— cook food for large meetings, weddings, etc.;
— undertake typing and word-processing assignments; and
— run small printing services.

Many schools have achieved considerable revenue through these methods. Commercial activities have the added benefit of giving students experience of the 'real world'.

(b) Problems

At the same time, however, certain problems must be noted:

i) *Disruption of the School Day*: The school authorities have to make it clear that products are only for sale during certain times. People must be discouraged, for example, from bringing vehicles

School Economic Activities: Two Successful Examples

1. Dominica

Since 1983, the Dominica Community College has engaged in many outside activities:

- *— for the Ministry of Education it has wired schools, plumbed buildings, and produced and repaired furniture;*
- *— for the Ministry of Health it has altered and furnished a Health Centre Resource Room; and*
- *— for other purchasers it has produced carnival costumes and uniforms.*

To date, over EC$40,000 has been earned. Half of that has been used for wages, allowances, tools, etc., and the remainder has been put in a fixed deposit bank account.

2. Jamaica

The Elim Agricultural School sells produce to the public, to the school canteen and to staff. Pigs are reared by the animal husbandry students, and the ham processed by the Home Economics Department has proved particularly popular. The school now has a monthly turnover of J$32,000 to subsidise its work.

for repair at all times of the day. And the school trade store can only be open after school hours, even if that means that the best times for trading are lost.

Similarly, when customers stress that a job is urgent, the school is tempted to sacrifice other learning (such as English lessons) for the sake of the commercial goal. Alternative benefits must be carefully weighed.

ii) *Disruption of the Curriculum*: Goods and services will only be marketable if the quality is reasonable. But the danger of this is excessive specialisation — that the school *only* produces iron gates or wooden tables, for example, because the students have

a lot of practice in making these things. This restricts the range of the students' learning.

In addition, contract work can force staff to change the sequence of a curriculum. For instance, from a pedagogic point of view they may wish to teach woodwork joints in a certain sequence; but the existence of a contract may force them to change the sequence.

iii) *Embezzlement of Funds*: The existence of commercial transactions increases the risk of staff and students misusing the funds. It is essential for school authorities to insist on proper accounting.

iv) *Poor Marketing Strategies*: Most teachers have been recruited because they are trained teachers — not because of their commercial skills. It should not be assumed that school staff know how to judge market fluctuations or what price to put on school goods. Many schools have experienced problems either of vegetables rotting because they have no market or of them having to be sold to staff at unrealistically low prices.

v) *Resentment from others in the Community*: Schools with commercial enterprises are almost certainly competing with the community's own artisans and businessmen. This may cause considerable tension in the community. Parents may argue that the job of the school is to teach — not to put local entrepreneurs out of business.

vi) *Disruption from Vacations*: School vacations may cause serious problems for school businesses: (a) the closure of trade stores etc. means a loss of regular customers, (b) jobs that are half finished at the end of term may remain uncompleted until the new term begins, (c) vegetables may miss the planting or harvesting seasons, and (d) animals may fail to receive proper care.

None of these problems are insuperable, and the positive aspects of commercial operation are again worth emphasising. However, the difficulties require careful attention. It cannot simply be assumed that a school with a practical curriculum is automatically capable of successful business.

12. Resources from the Community

Resources from the community take two main forms: (a) sponsorship for school projects, and (b) training through on-the-job experience.

(a) Sponsorship for School Projects
Sponsorship of school projects is commonly sought from:

— Parent-Teacher Associations,
— the whole community in the area surrounding the school,
— charitable organisations such as the Rotary Club and Lions Club, and
— local businesses and factories.

A companion Commonwealth Secretariat book in this series, called *New Resources for Education* (see the back cover of this book for details) discusses strategies in some detail. It pays particular attention to the need for clear project formulation, good financial accounting, and adequate accountability. Readers are referred to this book for further ideas, but it is meanwhile worth drawing out four particularly relevant points:

- Outside organisations become more willing to support projects that are well planned. They want to know that their money will be used properly, for its intended purpose.
- Most organisations prefer to help with capital rather than recurrent investments. They feel that capital investments are usually more visible, and do not entail an ongoing commitment.
- Because sponsors often provide only capital equipment, schools must ensure that they have enough money for recurrent costs, to implement and maintain projects.
- Different organisations may be willing to help with different aspects of the same projects.

(b) Training through On-the-Job Experience

Specific on-the-job experience can greatly increase the effectiveness of training. When industries and businesses help schools with such schemes, they are offering another form of community help.

The format and duration of work experience programmes varies. In Guyana and Dominica, for example, students are normally released for one day a week over a period of four to twelve weeks. In Jamaica and St Lucia, by contrast, pupils generally gain more concentrated experience, often during a vacation.

However, work-experience programmes are often hard to organise:

- the school must have the necessary initial contacts, and must keep in regular and friendly touch;
- the school must ensure that the students' experiences are worthwhile, and that they are not just used as a source of cheap labour; and
- the teachers must try to relate the school curriculum to a wide range of out-of-school contexts;

The boxes on pages 65 and 66 compare training on and off school premises, and highlight advantages and disadvantages.

How does Training in the School Compound Compare with Attachments to Industry or Business?

	ON SCHOOL PREMISES	OFF SCHOOL PREMISES
S	– Economic benefits to institution	– Students perform better in actual work situations.
T	– Agriculture programmes have positive influence on children's diet and nuttrition.	– Students gain experience of the world of work and their specific trade/ occupation.
R		
E	– The school environment is more balanced, having both academic and practical work.	– The transition from school to work is easier.
N		
G		
T	– In boarding schools, no transport costs.	– Students become aware of employers' expectations.
H		– Students gain experience with equipment that schools cannot afford.
S		

	ON SCHOOL PREMISES	OFF SCHOOL PREMISES
W	– Costly initial outlay.	– Some students unable to get appropriate work.
E	– Inadequate tools, materials etc.	– Students required to do menial tasks rejected by co-workers.
A		
K	– Products cannot compete with those from industries.	– Pupils may have long daily travel.
N		– Lack of opportunities in rural areas.
E	– Vacations disrupt work.	– Inadequate supervision.
S	– Shortage of instructors.	– Academic subjects get neglected.
S		– Employers make unrealistic demands
E		
S		

Part IV: Conclusions

13. Maximising Cost-Effectiveness

Many strategies are available to governments and school principals who wish to improve the cost-effectiveness of schools that teach practical subjects. The main factors are:

(a) improved management procedures, and
(b) strategies for maximising benefits.

(a) Improved Management Procedures

This book has highlighted a series of procedures for improving efficiency in the system. It has concentrated first on ways to maximise use of the expensive components of practical subjects, and second on ways to locate extra resources. Each school needs a management information system to enable the authorities to monitor income, expenditure and unit costs. Particular attention needs to be paid to:

— the design of buildings,
— wise investment in equipment and facilities,
— curricula that are sufficiently broad to provide a range of choices and help achieve objectives but are not so broad that they are uneconomic,
— optimum use of teachers of practical subjects and of support staff,
— efficient purchase and use of teaching materials,
— good systems for maintenance and repair, and
— systems for generating revenue from practical subjects.

It must be stressed that the most cost-effective systems are not necessarily the cheapest. For example, at several points this book has emphasised the potential value of training, which could be costly but could yield even greater returns. It is also again worth stressing the need for effective security systems and for insurance against theft and accident.

Chapter 3 pointed out that unit costs in business studies, for example, are much lower than costs in industrial arts and home economics. Administrators need to compare these costs with the benefits to see whether investment in expensive options is justified.

(b) Maximising Benefits

The following ways to maximise benefits are worth highlighting:

- Introduce subjects related to employment needs within the community.
- Facilitate opportunities for pupils to meet and discuss career prospects with appropriate firms and people.
- Offer subjects that provide job relevance and incentives in the neighbourhood.
- Provide follow-up for students when they leave school.
- Offer only subjects that the institution is well equipped to teach.
- Establish a system of certification that is understood by the community, is respected by its members and provides:
    - a measure of achievement,
    - an indicator of success, and
    - a qualification for employment.

Summary: Why Practical Subjects are Expensive

Capital Costs

Buildings	– *Workshops need more space per pupil* – *Raw materials and finished products need storage space* – *Workshops need (i) floors that can hold heavy machinery, and (ii) special lighting, temperature and humidity facilities* – *Workshops may need water, gas and electricity*
Equipment	*Specialised equipment is needed. Often it has to be imported* *New equipment must be bought to keep up with changing models and technologies* – *Vehicles may be needed to carry materials and produce*
Land	– *Workshops are usually larger than classrooms, so use more land* – *Agricultural science needs land for farming* *Animal husbandry needs land to house animals and provide food*

Recurrent Costs: Salaries

Teachers	– *Teacher costs per pupil are higher because (i) classes are smaller, and (ii) specialist staff often command higher salaries* – *Longer training may be needed for specialist staff*
Technical Support	*Technicians, workshop attendants, watchmen and farm hands may be required*
Administration	*Payment of extra salaries is required* – *Complex timetables must be drawn up* – *Insurance, stock keeping, etc must be organised*

Recurrent Costs: Non-Salaries

Teaching Materials	*Raw materials and routine replacements of equipment are needed*
Maintenance & Repairs	*Buildings and equipment must be maintained and repaired regularly*
Administration	– *Equipment, staff and pupils must be insured against fire and accidents* – *Examinations in practical subjects may be more expensive* – *Records must be kept on raw materials, sale of produce, etc*

Summary: Ways to Improve Cost-Effectiveness

Capital Costs

Buildings	– *Design multipurpose workshops.*
	– *Avoid overspecification of construction and equipment. obtain advice on local needs and materials from teachers and administrators.*
	– *Use buildings intensively, at lunchtimes, in the evenings and with double shifts.*
Equipment	– *Share expensive equipment with other schools.*
	– *Avoid imported items.*
	– *Choose equipment that can be maintained easily and at low cost.*
	– *Buy equipment in bulk, perhaps by joining orders with other schools.*
Land	– *Design multistorey buildings.*
	– *Confine agricultural science to land-intensive aspects, such as horticulture.*
	– *Share agricultural land between neighbouring schools.*

Recurrent Costs: Salaries

Teachers	– *Where possible, use specialist teachers only for specialist subjects.*
	– *If an individual school's demand for specialist teachers is too low, share specialists between schools.*
	– *Increase teaching loads and the size of classes.*
	– *Reduce costs of long pre-service training by providing in-service and on-the-job training.*
Technical Support	– *Employ technicians and supporting staff to relieve specialist teachers of routine work.*
	– *Require students to assist in workshop maintenance and repair.*
Administration	– *Establish procedures for stock control, purchasing, etc.,*

Recurrent Costs: Non-Salaries

Teaching Materials	– *Use locally-available materials.*
	– *Buy materials in bulk.*
Maintenance & Repairs	– *Decentralise maintenance and repair procedures, or use contract maintenance units.*
	– *Purchase equipment that is cheap to maintain.*
	– *Train teachers in basic maintenance and repair.*
Administration	– *Provide incentives for school managers to save money.*

Further Reading

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The dangers of an exclusively academic secondary school curriculum, and the benefits of a diversified one that includes practical and pre-vocational subjects, are acknowledgd throughout the world. Issues have been given particular prominence in less developed countries.

Diversification can be expensive, however, and this fact can seriously limit its scope and impact. To help governments both with decision-making and implementation, this handbook suggests ways to improve cost-effectiveness. It pays particular attention to the special facilities, equipment, staffing and class-sizes usually required by practical subjects.

The book is mainly intended for policy-makers and administrators at national government level. It will also be useful to inspectors, supervisors, principals and teachers.

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